

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 226

NORMAL EQUAL-LOUDNESS CONTOURS FOR PURE TONES
AND NORMAL THRESHOLD OF HEARING
UNDER FREE FIELD LISTENING CONDITIONS

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 226, *Normal Equal-Loudness Contours for Pure Tones and Normal Threshold of Hearing Under Free Field Listening Conditions*, was drawn up by Technical Committee ISO/TC 43, *Acoustics*, the Secretariat of which is held by the British Standards Institution (B.S.I.).

Work on this question by the Technical Committee began in 1957 and led, in 1959, to the adoption of a Draft ISO Recommendation.

In December 1959, this Draft ISO Recommendation (No. 352) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Austria	India	Romania
Belgium	Ireland	Spain
Burma	Italy	Sweden
Chile	Mexico	Switzerland
Colombia	Netherlands	United Kingdom
Czechoslovakia	New Zealand	U.S.A.
Denmark	Norway	U.S.S.R.
France	Poland	Yugoslavia
Hungary	Portugal	

One Member Body opposed the approval of the Draft: Germany.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in December 1961, to accept it as an ISO RECOMMENDATION.

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FOREWORD

Curves defining relations between frequencies of sounds and their sound pressure levels for the condition of constant loudness, i.e. "equal-loudness contours", are involved in many aspects of subjective acoustics. They are fundamental to a proper understanding of the function of the human ear in the perception of loudness. They also have important practical applications, for example in the development of methods of computing loudness from the physical properties of sounds.

The following ISO Recommendation specifies the equal-loudness contours and threshold of hearing for continuous sinusoidal tones for subjects of normal hearing under the conditions of binaural listening in free progressive plane waves, with the subject directly facing the source of sound.

It is emphasized that, since the contours here recommended relate only to pure tones presented in a specified manner in free field, they are not directly applicable to other types of sounds (e.g. bands of noise) or to other types of stimulus presentation (e.g. by earphone or with random incidence).

For these other types of sounds and other methods of presentation, contours appropriate to the circumstances will be needed, and may be issued as further data become available.

1. SCOPE

This ISO Recommendation specifies, for the frequency range 20 to 15 000 Hz (c/s) * and for the conditions stated below:

- 1.1 The normal relations existing between sound pressure level and frequency for pure tones of equal loudness.
- 1.2 Values for the normal threshold of hearing (normal binaural minimum audible field or MAF).

Conditions of applicability:

- (a) The source of sound is directly ahead of the listener;
- (b) The sound reaches the listener in the form of a free progressive plane wave;
- (c) The sound pressure level is measured in the absence of the listener;
- (d) The listening is binaural;
- (e) The listeners are otologically normal persons in the age group 18 to 25 years inclusive.

NOTE. Appendix B presents correction formulae to be applied to the above data in respect of otologically normal persons of other ages up to 60 years.

2. EXPLANATION OF TERMS

For the purpose of this ISO Recommendation, the following terms are employed, the pure tone, and the conditions of applicability stated in clause 1.2 being understood where appropriate.

- 2.1 *Equal-loudness relation*. A curve or function expressing, for a pure tone of given frequency, the relation between its loudness level, expressed in phons, and its sound pressure level, expressed in decibels.
- 2.2 *Equal-loudness contour*. A curve in the sound pressure level/frequency plane, connecting points whose co-ordinates represent pure tones judged equally loud.
- 2.3 *Normal equal-loudness relation (contour)*. The equal-loudness relation (contour) corresponding to the judgments of otologically normal subjects within the age limits 18 to 25 years inclusive.
- 2.4 *Threshold of hearing (binaural minimum audible field)*. For a given person at a specified frequency, the minimum value of the sound pressure level which excites the sensation of hearing.
- 2.5 *Normal threshold of hearing (normal binaural minimum audible field or MAF)*. At a specified frequency, the value of the threshold of hearing corresponding to the judgments of otologically normal subjects within the age limits 18 to 25 years inclusive.

NOTE. An "otologically normal subject" is understood to be a person in a normal state of health who is free from all signs or symptoms of ear disease and from wax in the ear canal.

* Hz (Hertz): International use
c/s (cycles per second): Used in United Kingdom and U.S.A.